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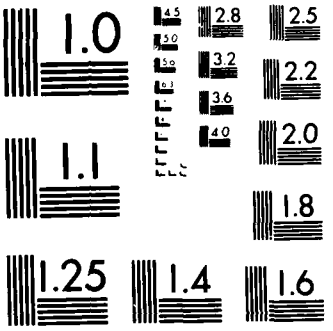

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Mathematical software, concurrent computing

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Research concentrated on designing and implementing a microprocessor based concurrent computing environment consisting of a number of Intel microprocessors with IEEE floating point arithmetic implemented in hardware. The major focus of our work was the design of a concurrent tasker in software to locate code and data, monitor computation and communication and report results to the user. The construction of viable numerical algebra modules in an IEEE floating point arithmetic was and continues to be part of the research.

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FINAL REPORT--ARO Grant DAAG29-82-K-0028,"Numerical Algorithms and Mathematical Software for Linear Control and Estimation Theory," Virginia Klema, Principal Investigator, MIT Statistics Center, Cambridge, MA 02139

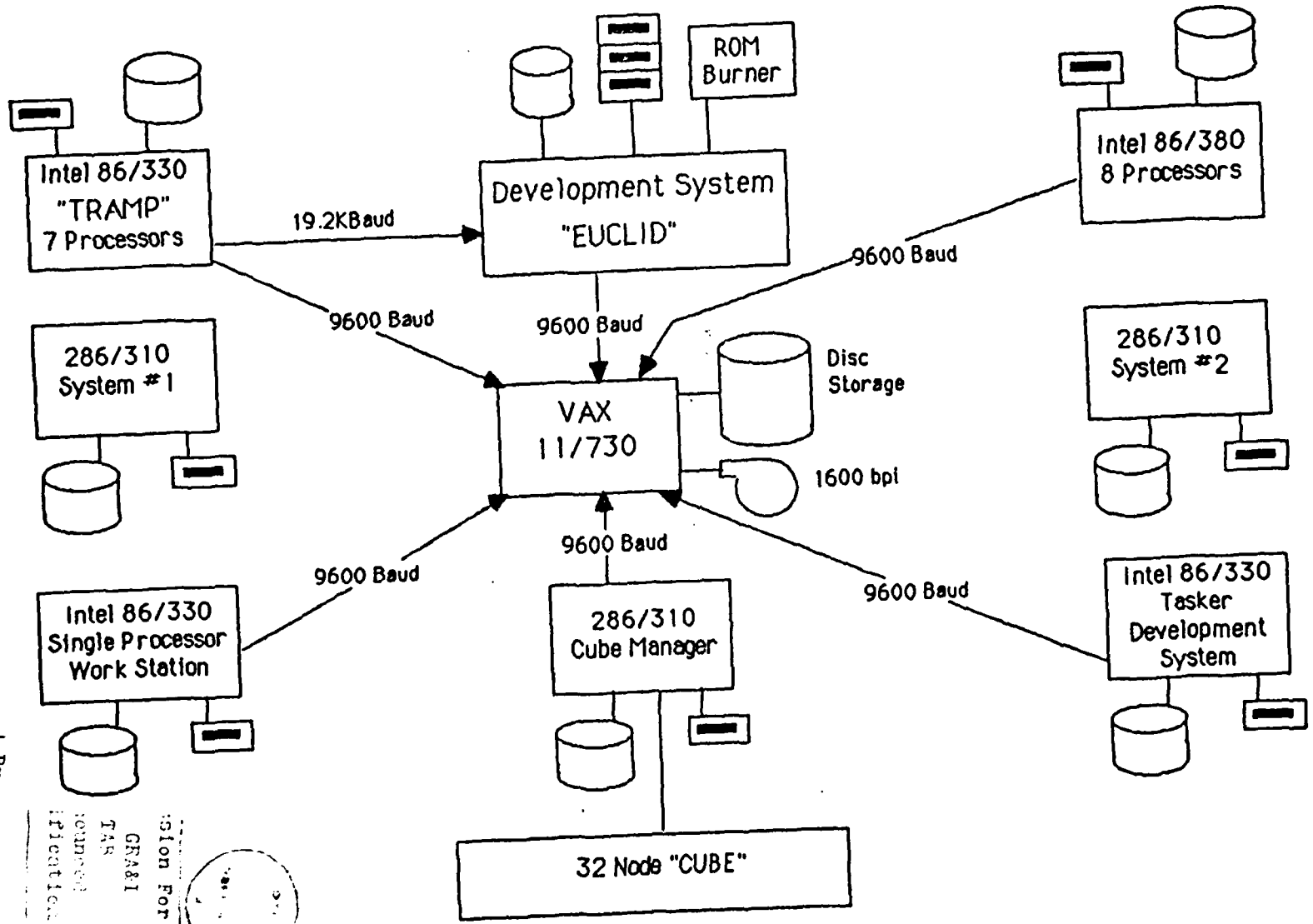
Interim reports filed within the period of research funding indicate the level of research effort, research results presented at professional meetings, and the level of contact with personnel at ARO Laboratories.

A portion of the research funding provided by ARO was used to acquire a modest number of concurrent computing instruments that form the concurrent computing facility shown in diagram form on the succeeding page of this report.

Our research concentrated on the design and implementation of a concurrent computing environment consisting of Intel microprocessor based components. The innovation of IEEE floating point arithmetic corresponding to P754, the IEEE standard for binary floating point arithmetic, on the Intel 8087, and later 80287, chips provided the impetus to attempt concurrent computing in a real environment, not merely a presumed one.

A major goal of our research was the design and implementation of a parallel tasker, software to load and locate code and data, initiate and monitor computation and communication among processing elements, and report results to the user. The software tasker was designed and implemented with the aim of serving the needs of the numerical analyst whose research is numerical algorithms in a concurrent computing environment. We strongly believe that concurrent computing is best studied and done with particular applications in mind, and we have focussed on signal processing applications and the associated numerical algebra components that form the foundation for these applications. In particular, we focus on the need for real-time signal processing applications and the associated updating algorithms that are required.

CONCURRENT COMPUTING LABORATORY



A significant result of our research activity is that given the initial choice of Intel components for the microprocessors that we use, our design concepts and software will be able to be transferred to the recently announced and commercially available Intel cube. The 32 node cube, iPSC/d5, will be in place here July 15th. Experience thus far has been limited to the other multiple microprocessor workstations shown in the diagram of our concurrent computing equipment.

A key element in each of our microprocessors is the Intel 8087 or 80287 chip that implements the recommendations as well as the mandatory components of the binary standard for floating point arithmetic. For the first time we have floating point arithmetic that is free from the many anomalies of poorly designed main-frame arithmetic. While this freedom is quite encouraging for the novice as well as the experienced and sophisticated user, we must provide exception handlers for floating point arithmetic exceptions, overflow, underflow, denormals, zero-divide, invalid operation, and inexact when subordinate to overflow or underflow. Experience has shown that these exception handlers are expecially needed for concurrent computing in the presence of minimal operating systems on worker processors.

Furthermore our research has revealed a need for monitoring execution, code and data assignment, and communication strategies in such a way that these results can be displayed to the user in graphics mode. Ongoing research is addressing this critical issue.

Personnel supported during this research period include George Cybenko, Elizabeth Ducot, Virginia Klema, Randall Barron (post-doctoral appointee), Richard Kefs (Master's student in minimal operating systems), and other associated undergraduate and graduate students.

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